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Title: Light interventions: a novel approach for sustaining sleep quality and quantity of elite swimmers under conditions of shifted circadian rhythm

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Abstract: For the 2016 Olympics at Rio De Janeiro the Danish swimmers was facing a very important problem, how to maintain a good sleep quality, quantity and high performance potential^{1,2}, while being subject to large shift in circadian rhythm. In the present study we suggest an alternative approach for sustaining sleep quantity and quality, namely light interventions. A light program, comprising of alternating blue enhanced white light and blue suppressed white light, was designed to complement the activities of elite Danish swimmers after arriving to preparation/training camp; mimicking the conditions expected in the 2016 Summer Olympics in Rio (5-10 hours shift in circadian rhythm). The sleep patterns of the swimmers were monitored throughout two different phases: the baseline period, registered both before and after the intervention; and the preparation period (intervention). Sleep duration, efficiency, latency, percentages of light, deep or REM sleep were the variables under investigation. The sleep output was modeled (ANOVA) with subject as a random effect and phase as fixed effect. It was observed that the light program during the intervention phase significantly enabled the conservation of sleep quantity and quality of the swimmers, despite the shifted circadian rhythm. The hypothesis of no effect of phase of experiment on sleep duration, efficiency, latency, percentage of light, deep and REM sleep were all accepted with p. values 0.17, 0.53, 0.90, 0.38, 0.57 and 0.52, respectively. The swimmers commented only positively the light interventions and decided to use them at Olympics 2016. No side effects were observed.

Light interventions could become an alternative simple tool for coaches and elite swimmers to improve sleep patterns in occasions of disturbed circadian rhythm conditions (different time zones, uncomfortable competition times). Contrary to other methods for improving sleep pattern (e.g. sleeping pills) light interventions carry minimal risk for severe side effects³.

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